



Fluorinert™ Liquids

For Electronics Manufacturing

Product Information

Introduction

3M™ Fluorinert™ liquids are a family of clear, colorless, odorless, inert perfluorinated fluids having a viscosity similar to water but approximately 75% greater density. These non-flammable liquids have set the standard in the electronics industry for 40 years, meeting the demanding and diverse requirements of many heat transfer, manufacturing and testing applications.

Fluorinert liquids are thermally and chemically stable, compatible with sensitive materials, including metals, plastics and elastomers, and are practically non-toxic.

Fluorinert liquids are completely fluorinated, containing no chlorine or hydrogen atoms. The strength of the carbon-fluorine bond contributes to their extreme stability and inertness. This chemical structure also results in very low intermolecular forces, low surface tension and essentially no solvent action on non-fluorinated compounds.

The dielectric strength of perfluorinated liquids is high—in excess of 35,000 volts across a 0.1 inch gap. Water solubility is on the order of a few parts per million. The nominal boiling point of each fluid in this series is determined during their manufacture. Fluorinert liquids are available with boiling points ranging from 30°C to 215°C and pour points as low as -101°C.

3M™ Fluorinert™ Liquids Typical Properties

(Not for Specification Purposes)

All values determined at 25°C unless otherwise specified

Fluorinert Liquid	FC-87	FC-72	FC-84	FC-77	FC-104	FC-75	FC-3283	FC-40	FC-5320	FC-43	FC-70	FC-5312
Average Molecular Weight	290	340	388	415	435	420	521	650	650	670	820	820
Typical Boiling Point, °C	30	56	80	97	101	102	128	155	160	174	215	215
Pour Point, °C	-101	-90	-95	-95	-65	-88	-50	-57	-65	-50	-25	-25
Density, g/cm ³	1.63	1.68	1.73	1.78	1.77	1.77	1.82	1.87	1.87	1.88	1.94	1.93
Density, -54°C g/cm ³	1.84	1.90	1.93	1.97	1.96	1.96	□	□	□	□	□	□
Kinematic Viscosity, cs	0.4	0.4	0.55	0.8	0.8	0.8	0.75	2.2	2.2	2.8	14.0	12.6
Kinematic Viscosity, -54°C cs	1.1	1.9	4.0	6.9	7.3	7.4	□	□	□	□	□	□
Vapor Pressure, torr	610	232	79	42	29	31	11	3	3	1.3	<0.1	<0.1
Specific Heat, cal/g - °C	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Heat of Vaporization @ Boiling Point, cal/g	24	22	19	20	22	21	18	17	17	17	16	16
Thermal Conductivity, watts/(cm ²) (°C/cm)	0.00056	0.00057	0.00060*	0.00063*	0.00063*	0.00063	0.00066*	0.00066*	0.00066*	0.00066	0.00070*	0.00070*
Coefficient of Expansion cm ³ /(cm ³)(°C)	0.0016	0.0016	0.0015	0.0014	0.0014	0.0014	0.0013	0.0012	0.0012	0.0012	0.0010	0.0010
Surface Tension, dynes/cm	9.5	12	13	15	14	15	16	16	16	16	18	18
Refractive Index	1.238	1.251	1.261	1.280	1.271	1.276	1.2813	1.290	1.290	1.291	1.303	1.303
Dielectric Strength, KV(2.54 mm gap)	42	38	42	40	41	40	43	46	46	42	40	40
Dielectric Constant, (1KHz)	1.72	1.76	1.81*	1.86	1.86	1.86	1.89	1.89	1.89	1.90	1.98	1.98
Dissipation Factor, (1KHz)	<0.0005	<0.0003	<0.0003*	<0.0003	<0.0001	<0.0001	<0.0003*	<0.0003	<0.0003	<0.0001	<0.0001	<0.0001
Volume Resistivity, ohm-cm	5.8x10 ¹⁵	1.0x10 ¹⁵	1.0x10 ¹⁵	1.9x10 ¹⁵	8.4x10 ¹⁵	8.0x10 ¹⁵	5.0x10 ¹⁵ *	4.0x10 ¹⁵	4.0x10 ¹⁵	3.4x10 ¹⁵	2.3x10 ¹⁵	2.3x10 ¹⁵
Solubility of Water ppm(wt.)	7	10	11*	13	11	11	7*	7	7	7	8	8
Solubility of Air ml gas/100 ml liquid	54	48	43*	41	38	40	30*	27	27	26	22	22

* Estimated values

□ Not measured due to relative proximity to pour point

**Thermal Shock
Testing Liquid
3M™ FC-6003
Typical**

Properties
(Not for Specification
Purposes)
Low Temperature
Reservoir

Density @ 25°C, gm/ml	>1.76
Dielectric Strength, volts/mil	>350
Viscosity @ -75°C	<50
Residue, micrograms/ml	<10
Appearance	Clear/colorless liquid

**3M™ SF-2
Secondary Fluid
Typical
Properties**
(Not for Specification
Purposes)

	Test Number
Boiling Point, °C	46.0°C ± 8.0° 66.1
Density @ 25°C, gm/ml	1.600 - 1.900 14.5
Residue, micrograms/ml	10 Max 1.13.5.2
Appearance	Clear/colorless liquid Visual

**Typical
Applications**
Boiling Points

MIL. STD. Tests:

Gross Leak	Detector Fluids (Bombing)	FC-72	56°C
	Bubble Tank or NID	FC-84	80°C
	Indicator Fluids (Bubble Tank)	FC-40	155°C or
		FC-43	174°C
Thermal Shock	Cold Side	FC-77 or FC-6003	
	Hot Side	FC-40 or FC-43	

Liquid Burn In & ESS (Environmental Stress Screening):

FC-40	155°C
FC-5320	160°C "Thermally Stabilized"
FC-43	174°C

VPS Vapor Phase Soldering:

Primary	FC-70	215°C
	FC-5312	215°C "Thermally Stabilized"
Secondary	SF-2	46°C

Cooling/Thermal Management:

FC-77	97°C
FC-3283	128°C
FC-43	174°C
FC-70	215°C

High Voltage/Dielectric Testing: All 3M™ Fluorinert™ Liquids have high dielectric strength

Constant Temperature Baths/Calibration: Match the Boiling Point and Pour Point

**Materials
Compatibility**

3M™ Fluorinert™ Liquids are compatible with most metals, plastics and elastomers.

Toxicity Profile

Fluorinert liquids are non-irritating to the eyes and skin, and are practically non-toxic orally. They also demonstrate very low acute and sub-chronic inhalation toxicity. These products are not mutagens or cardiac sensitizers.

**Safety and
Handling**

Fluorinert liquids are nonflammable, and are highly resistant to thermal breakdown and hydrolysis in storage and during use. Recommended handling procedures are given in the Material Safety Data Sheets, which are available upon request.

Environmental

Fluorinert liquids have zero ozone depletion potential. These materials are not defined by the U.S. EPA, nor regulated, as volatile organic compounds (VOCs) and do not contribute to ground-level smog formation.

Fluorinert liquids, which are perfluorocarbon (PFC) materials, have high global warming potentials and long atmospheric lifetimes. As such, they should be carefully managed to minimize emissions.

3M recommends that users of Fluorinert liquids further limit emissions by employing good conservation practices, and by implementing recovery, recycling and/or proper disposal procedures. 3M offers a program for used fluid return. Specific guidelines for the safe handling and use of 3M products are provided in the Material Safety Data Sheets.

Resources

For additional technical information on Fluorinert liquids, contact

3M Specialty Materials
3M Center, Bldg. 223-6S-04
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800 810 8513
800 810 8514 (Fax)

Or visit our web site at www.3m.com/electronicmaterials

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